Overview

Using computers to deliver materials information is now a reality. Many groups that previously published are now using data bases to make available to the general public property data for metals, alloys, composites, polymers, and plastics. Many more data bases are being developed for individual companies.

In spite of all this activity, building, distributing, and using materials data bases is not yet routine or necessarily easy. Of all the materials data bases that now exist, no two of them are compatible in any significant way. The user interfaces are different, the nomenclature varies, and different data are collected, even for the same test methods. Unfortunately, all this incompatibility lies on top of the chaotic hardware and software situation.

ASTM has established Committee E49 on Computerization of Material Property Data to develop standards and guidelines for materials data bases. The goal is not to impose rigidity or hinder innovation, but rather to develop a common basis for handling materials data on computers. The key questions being addressed are as follows:

1. How can materials be described and identified in data bases?
2. What data items must be reported with test results to make them meaningful?
3. How should these data be reported? In what format?
4. What information should the user interface contain?
5. How can the developed guidelines be used in data base building?
6. How can data from two different data bases be accessed and combined?
7. How do you indicate the quality of data in data bases?

The standards will allow builders of materials data bases to draw on the experience of the community in answering these and similar questions. Users will be able to access different data bases more uniformly. Distributors of data bases will be able to maintain compatibility from one data base to another.

Enough progress has been made in the two years the Committee E49 has operated to make it worthwhile to involve the materials data base community in an open forum to exchange ideas on what has been done and what needs to be done next. That forum became the First International Symposium on Computerization and Networking of Materials Property Data Bases, held in Philadelphia, PA, on 2-4 Nov. 1987, and attended by 128 experts from 11 countries. The presentations covered many aspects of materials data bases:

- Standards activities
- National and international activities
- Emerging issues
- Impact
- Data base projects
- Cooperative data base programs

The papers in this volume are grouped according to these categories. Before describing them, some general conclusions can be drawn.

The state of the art of materials data bases had advanced rapidly with respect to the coverage of materials. Of the major classes of structural engineering materials, polymers, metals, and composites all have substantial data bases. These are being distributed both publicly and within private organizations. The general situation seems to be the same in the United States, the European Community, Japan, and China.

Aside from the coverage, the situation for materials data bases can best be described as lots of ideas and many goals but few successes. Some important points can be made:

- Standards for materials data bases have considerable support, and there is a strong desire for international compatibility of these standards. The standards, however, are not yet in place.
- Most industrial countries have made a commitment to develop an integrated network of individual data bases. Implementation varies considerably and most efforts have found that the work is going more slowly and costs more than originally anticipated.
- The impact of materials data bases is recognized to be indirect, thus making its calculation very difficult. This is further reflected by the difficulty some data base providers have had in getting started.
- Personal computer data bases of materials data are much further advanced than networks. Although individual PC data bases have attractive manipulation and display features, they do not now contain very much data.
- Very few data bases have a full range of test data and most do not include property data as a function of temperature or other conditions.
- Expert systems linked to user interfaces and integration of materials data bases into other computerized engineering tools are high-priority goals, but more research must be done.
- Significant problems still exist with respect to capturing the richness and complexity of materials data.
- In the United States, cooperative data base programs have been very successful in drawing upon industrial and government resources to improve the quality and accessibility of materials data.

Standards for Materials Data Bases

In his paper, Kaufman describes the activities of ASTM Committee E49 on Computerization of Materials Property Data. A full discussion is given of the types of standards being developed. Westbrook gives a detailed example of one E49 standards area, the identification of metals and alloys. Reynard discusses international aspects of materials data base standards, focusing on the recent activities of the Versailles Project on Advanced Materials and Standards (VAMAS). Great concern has been expressed by many people in this field that standards developed by individual countries must be compatible, and VAMAS, in conjunction with E49, has been defining the issues involved.

National and International Materials Data Base Activities

Almost every industrialized country has a major effort to make materials data bases available by on-line computer networks. The papers in this section give an overview of notable examples of these efforts. Kaufman discusses the National Materials Property Data Network, Inc., a cooperative effort between industry and technical societies in the United States to build such a network. Kröckel and Steven present the efforts of the EEC on a similar network that involves data bases from many European countries. While the goals of the two groups are about the same, the approaches are quite different as are the sources of support.

Three papers describe aspects of other national efforts for materials data bases. Lu and Fan cover activities in China, which include an impressive list of areas where work has started. Nishijima, Momma, and Kanao discuss work in Japan, especially at the National Research

Institute of Metals. Finally, Bathias and Marx give the results of a recent survey done in France on the need and acceptance of materials data bases.

The paper by Barrett covers the activities of the Committee on Data for Science and Technology (known as CODATA) of the International Council of Scientific Unions. CODATA provides a forum for cooperative data work on an international scale, and its task group on materials data bases will be important in future years.

Emerging Issues

Materials data are rich and complicated. The data themselves are an integral part of engineering and manufacturing. The interpretation of these data, especially in the context of various applications, comes close to being an art.

The set of papers in this section deals with these issues from the perspective of computerization: How to capture the complexity? How to integrate materials data bases with other software? How to incorporate expert systems?

Most of the ideas presented here are new and have not been incorporated in working systems. Some are drawn from other fields. Some are embryonic. They are important ideas and, even though some of the papers require serious reading and rereading, this will be well worthwhile. Su and Furlani have been leaders in the integration of engineering data bases, especially in computer-aided design (CAD) and computer-aided manufacturing (CAM). It is the dream of many to link materials data bases into CAD/CAM systems, and these papers give important background.

McCarthy and Grattidge have played key roles in the development of prototype Materials Information for Science and Technology system in the United States and discuss important aspects of handling materials metadata and data capture. Many of the issues raised are still problems that must be solved before large-scale materials data networks will exist.

In his paper, Iwata presents some thought-provoking ideas on the need for expert systems as part of the interface to materials data bases. The final paper of this section is by Pilgrim et al. covers an important approach to querying materials data bases.

Impact of Material Data Bases

Little has been written as to the impact that materials data bases will have on engineers in their work, or the related issue, the lack of perceived impact. Burte and Harmsworth describe how data bases affect the unified life cycle engineering concepts being developed by the U.S. Air Force. Little and Coyle cover how materials data bases relate to other work in the aerospace industry.

The other two papers look at the impact issue from the point of view of overcoming the lack of perceived impact. Martini-Vvedensky discusses the problems of starting a business based on materials data bases, while Rumble looks at various socio-economic issues that provide barriers to progress.

Materials Data Base Projects

This section of papers contains descriptions of a variety of materials data bases, built for many reasons. Petrisko, Moniz, Ranger, and Lees et al. all describe materials data bases built for their companies. Li and Ho and Newton and Gall discuss data bases built for the U.S. government. Schenck and Dennis, and Ondik and Messina cover work of the American Ceramics Society and NBS on phase diagram data bases.

Cooperative Materials Data Base Programs

Over the last decade, several large data programs in the United States have addressed industrial needs for high-quality, easily accessible materials data. These have been cooperative programs between technical societies, industry, and government.

Anderson and Laverty discuss the corrosion data program of the National Association of Corrosion Engineers (NACE) and the National Bureau of Standards (NBS). Scott et al. describe the Alloy Phase Diagram Program of ASM International and NBS, which has had many contributions from other countries. Jones and Vanderveldt cover the welding data program of the American Welding Institute. To end this section, Jahanmir, Hsu and Munro discuss the new tribology data program involving NIST, the Department of Energy, the American Society of Mechanical Engineers, and American Society of Lubrication Engineers.

Summary

The editors hope that the readers of this volume will come away with an understanding of the present-day status of materials data bases, both in the United States and internationally. There are many ideas, old and new, that should be useful. In future years, we look forward to seeing these ideas become reality.

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